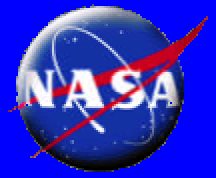
NASA's Aviation Safety Program

Overview for I-CNS Workshop



April 30, 2002
Douglas A. Rohn
Act. Deputy, NASA Aviation Safety Program
Glenn Research Center

NASA's Aerospace Technology Enterprise

NASA Aviation Safety Program

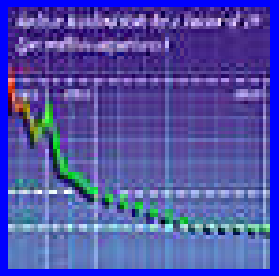
Goal 1: Revolutionize Aviation

Enable a safe environmentally-friendly expansion of aviation

Aeronautics Technology Objectives:

1. **Increase Safety**

   Reduce the aircraft accident rate by a factor of five within 10 years, and by a factor of ten within 25 years
2. Reduce Emissions
3. Reduce Noise
4. Increase Capacity
5. Increase Mobility



NASA's strategies for reducing the accident rate are:

- **Aviation System Modeling-**Use the vast amounts of data available within the aviation system to identify and correct aircraft system problems before they lead to accidents.
- **Accident Prevention-**Identify interventions and develop technologies to eliminate the types of accidents that can be categorized as "recurring."
- **Accident Mitigation-**Reduce the risk of injury in the unlikely event of an accident.

AvSP Organization

NASA Aviation Safety Program

Aviation Safety Program Office

Samuel A. Morello, Director
Vacant, Deputy Director
Glenn Bond, Senior Prog Analyst
Connie Smith, Secretary
Brian Smith, Dep Prog Mgr (ARC) Doug Rohn, Dep Prog Mgr (Acting, GRC)

Technical Integration
Frank Jones
(LaRC)

Program Integration
Michael Basehore (FAA)
Carrie Walker (HQ)

Projects

- **1.3** Vehicle Safety Technology
- **1.4** Weather Safety Technology
- **1.5** Systems Safety Technology

Elements

- **2.3** Single Aircraft Accident Prevention — John White (LaRC)
- **2.6** Synthetic Vision — Daniel Baize, Cheryl Allen (LaRC)
- **2.5** Accident Mitigation — Robert McKnight (GRC)
- **2.4** Weather Accident Prevention — K. Martzakis (GRC)
- **2.7** Aircraft Icing — Mary Wadel (GRC)
- **2.1** Aviation System Monitoring & Modeling — Irving Statler (ARC)
- **2.2** System-Wide Accident Prevention — Tina Beard (ARC)
- **2.8** Search and Rescue — David Affens (GSFC)

Revolutionize Aviation – Aviation Safety

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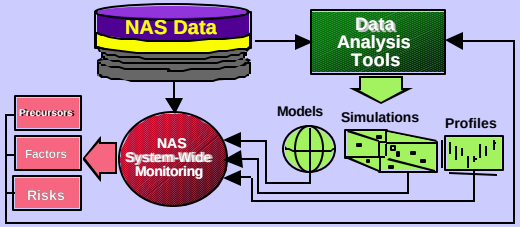
System Safety Technologies

Aviation System Monitoring & Modeling

Monitors and assesses data from every flight for known & unknown issues



System-Wide Accident Prevention

Improves human/machine integration in design, operations, & maintenance

Weather Safety Technologies

Icing Research

Icing detection and protection systems, training aids, tools for design and certification of aircraft systems

Weather Accident Prevention

Brings intelligent weather decision-making to every cockpit

Vehicle Safety Technologies

Synthetic Vision

Provides commercial & general aviation pilots with clear-day operations all of the time

Accident Mitigation

Increases survivability when accidents occur

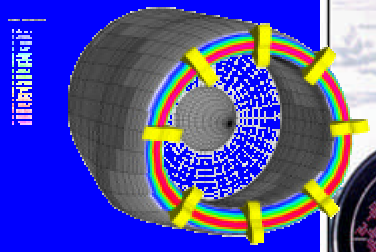
Single Aircraft Accident Prevention

Develops health management & robust control technologies to enable aircraft that are "self healing" & "refuse to crash"

Aircraft Icing:

Eliminate Icing as Safety Hazard

NASA Aviation Safety Program



Challenges

- Simulation tools and analytical models for ice accretion
- Accurate evaluation of aircraft performance in icing conditions
- Intelligent ice protection systems
- Accurate ground-based and airborne measurement of local icing conditions
- Lack of icing specific education and training tools

Weather Accident Prevention:
Intelligent Weather Decision Making

NASA Aviation Safety Program

Honeywell Weather Information Network (WINN) system used in UAL In-Service Evaluation demonstrated time savings and turbulence mitigation. Rapid-prototyped with off-the-shelf communications technologies (air phone, ACARs)

Rockwell Enhanced Weather Radar (EWxR) system demonstrated the display of uplinked NEXRAD data combined with on-board radar data to provide the pilot with graphical weather information

Weather Accident Prevention:
Intelligent Weather Decision Making

NASA Aviation Safety Program

ARNAV Weather Hazard Information system demonstrated the display of weather products in a GA cockpit

Evaluated the impact of graphic weather information on pilot decision making with the Honeywell GA tethered weather information display

Weather Accident Prevention:
Intelligent Weather Decision Making

NASA Aviation Safety Program

Low Altitude Airborne Weather Sensing & Reporting

- TAMDAR (Tropospheric Airborne Meteorological Data Reporting)

TAMDAR
Sensor

Twin Otter

Key issues to success of concept:

- System reliability, affordability
- Collection, processing of massive amount of data
- Dissemination to users

Weather Accident Prevention:
Eliminate Severe Turbulence Hazard

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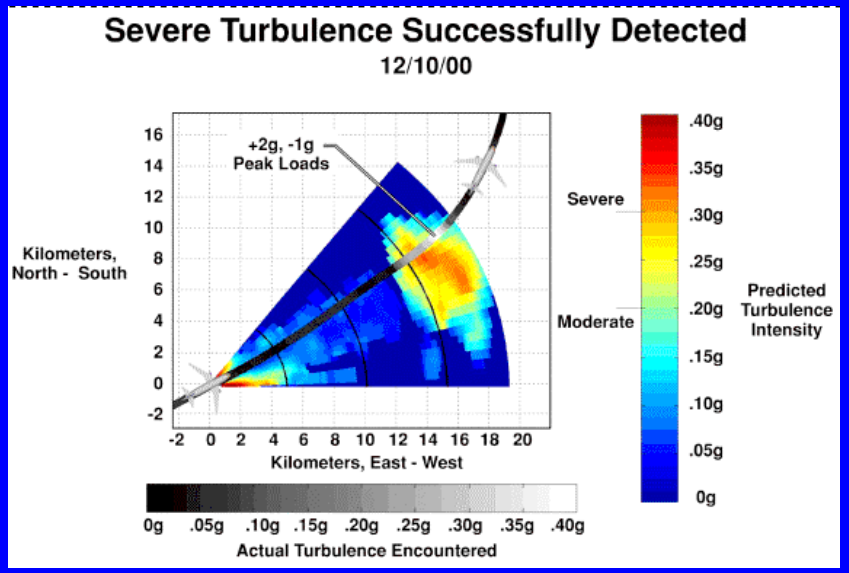
Predicting and Avoiding Turbulence

- Working with industry and the FAA, NASA researchers are conducting flight experiments with radar and lidar systems for predicting turbulent airspace ahead of the aircraft.

- NASA researchers are also adapting wind shear radars onboard aircraft to provide a turbulence alert system allowing pilots enough time to warn flight attendants and passengers to buckle up.



Weather Accident Prevention:
Intelligent Weather Decision Making

NASA Aviation Safety Program

Other issues:

- Quality of aviation weather products at altitude
  - Limited by ground observations
  - Need higher resolution, timely, accurate observations at altitude
    - Satellite-based aviation weather products

- Wx communication capacity limitations
  - Line-of-sight, bandwidth, time-critical terminal-area needs
    - Satellite-to-aviation technologies

Synthetic Vision Systems:

Make Every Flight Clear Day Operation

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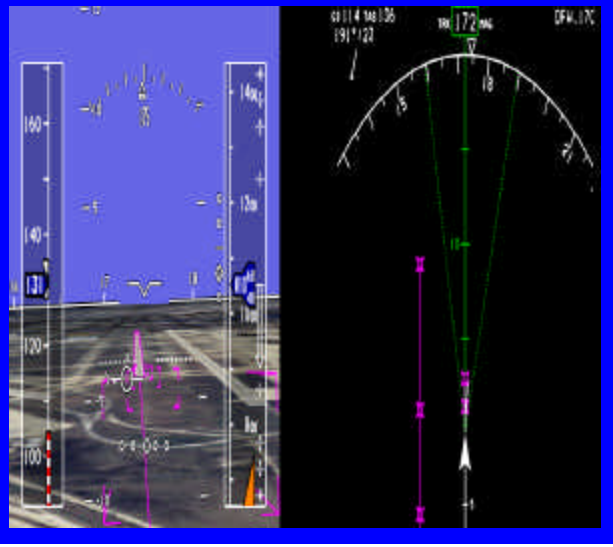
Airport moving map on nav display
- Ownship location
- Approved route
- Incursion alerting

Results to Date

- SVS improves Situation Awareness
- Runway conflict alerts effective
- Collins runway object detection radar application launched

SVS proven effective on head-up display (HUD above) and primary flight display (PFD below)



System Aircraft Accident Prevention:
Health Management & Robust Controls

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ACAMS Processor

- The Aircraft Condition Analysis and Management System (ACAMS) was demonstrated and successfully identified intentional faults in flight data during real-time simulations.
- The system predicted the impact of the failure scenarios allowing corrective maintenance action to take place prior to catastrophe.

Accident Mitigation:
Increase Survivability & Prevent Fires

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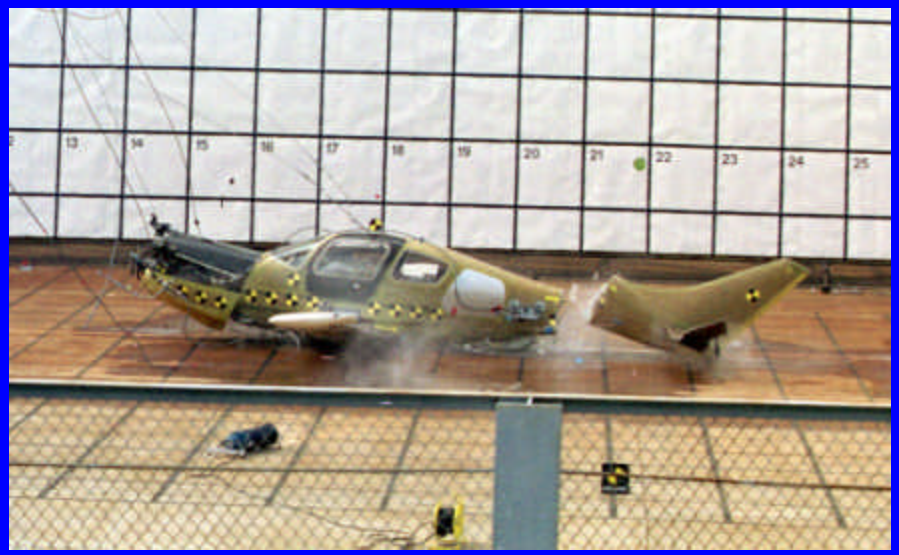
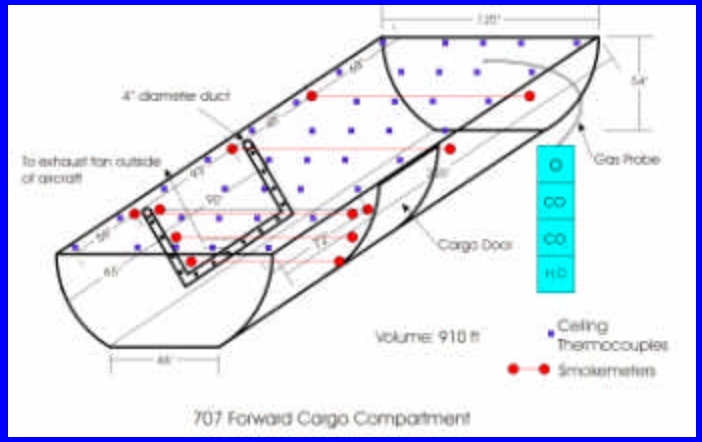


Improved structural modeling/prediction codes



Validated low false alarm fire detection design concepts through testing and analytical modeling of cargo compartment fire signatures.

System Wide Accident Prevention:
Human-Machine Integration

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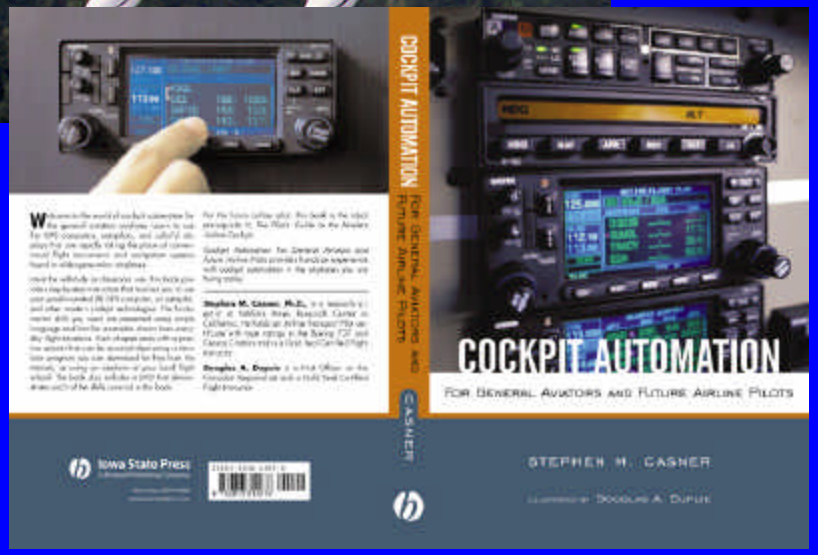
Starts student learning about cockpit automation in small training airplane



Iowa State University Press

Advanced portion of the training program for future airline pilots

Transitions student from small training airplane to commercial jet airliner

Iowa State University Press (June 2001)

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scasner@mail.arc.nasa.gov

Aviation System Monitoring & Modeling:
Monitor and Assess All Data From Every Flight

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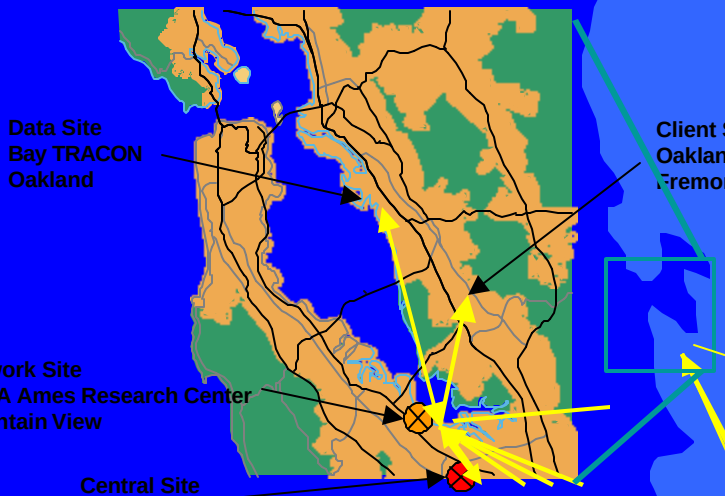
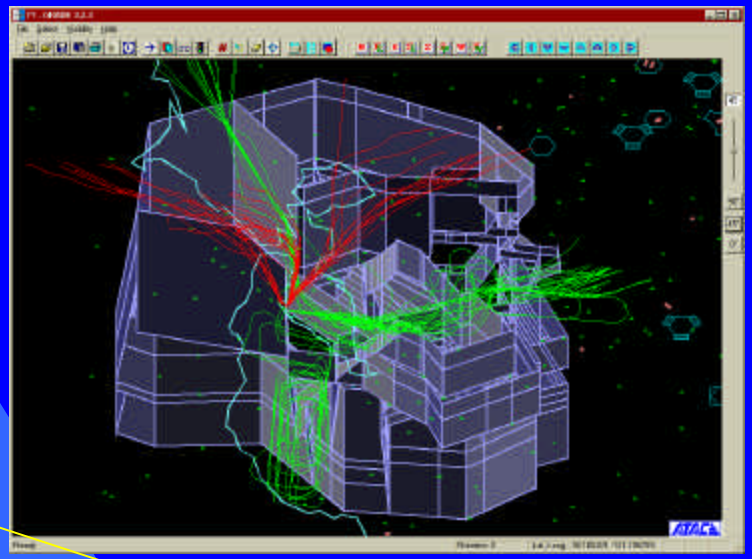




Client Site
Los Angeles Center
Palmdale

Client Site
Western Pacific Regional Office
Lawndale

Data Site
Southern California TRACON
San Diego

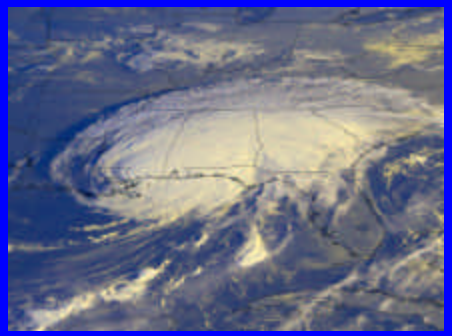
- PDARS (Performance Data Analysis and Reporting System) tools are in daily use at FAA ATC facilities in southern CA.
- Evaluating safety, flexibility, access, predictability, and delay.
- FAA announced the expansion of PDARS to the entire Southwest Region.

Future Safety Initiative:
Potential Research Areas

NASA Aviation Safety Program

Total Aircraft and Airspace Safety Integration

- On-line capability for analysis of safety
- Systems to eliminate component failure and maintenance as accident factors
- Integrated communications/ATM architecture



Integrated Hazard Awareness and Avoidance

- System integration of hazard alerting, avoidance, and tolerance subsystems
- Concepts for full recovery from any aircraft upset
- Integrated designs and methods to support certification

Fully Intuitive Flight Deck

- Revolutionize flight deck design concepts through immersive interfaces
- Safety-optimal human/automation interactions
- Adaptations considering future of NAS procedures

System Safety Communications

- Support real-time analysis & monitoring
- Integrated CNS for safety
- Future NAS sub-systems & procedures

Search & Rescue Project

NASA Aviation Safety Program

- To provide technical support to NOAA and other Federal agencies in their operation and use of the NASA-developed international Cospas-Sarsat satellite based search and rescue system. The system is credited with aiding in saving over 13,000 lives.

- To develop enhancements to the satellite-based search and rescue support systems.
- To apply aerospace technology to search and rescue needs.
- To be an active citizen of the search and rescue community.